SOLICITATION, OFFER AND AWARD	1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 350) ▶	RATING	PAGE OF
		DO-C9	1 | 27 PAGES

2. CONTRACT NO.	3. SOLICITATION NO.	4. TYPE OF SOLICITATION	5. DATE ISSUED	6. REQUISITION/PURCHASE NO.
	N00173-00-R-MS05	☐ SEALED BID (IFB) ☒ NEGOTIATED (RFP)	06/23/00	10-8181-00

7. ISSUED BY CODE
CONTRACTING OFFICER
NAVAL RESEARCH LABORATORY
ATTN: CODE 3220.ms
WASHINGTON DC 20375-5326

8. ADDRESS OFFER TO *(If other than Item 7)*

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

SOLICITATION

9. Sealed offers in original and 3 copies for furnishing the supplies or services in the Schedule will be received at the place specified in Item 8, or if handcarried, in the depository located in Bldg 222, Rm 115 until 4:00pm *(Hour)* local time 07/25/00 *(Date)*

CAUTION - LATE Submissions, Modifications, and Withdrawals: See Section L, Provision No. 52.214-7 or 52.215-10. All offers are subject to all terms and conditions contained in this solicitation.

10. FOR INFORMATION CALL: ▶	A. NAME	B. TELEPHONE NO. *(Include area code) (NO COLLECT CALLS)*
	Ms. Mary M. Sandy	202-767-3710

11. TABLE OF CONTENTS

(✓)	SEC.	DESCRIPTION	PAGE(S)	(✓)	SEC.	DESCRIPTION	PAGE(S)
		PART I - THE SCHEDULE				PART II - CONTRACT CLAUSES	
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OFFER *(Must be fully completed by offeror)*

NOTE: Item 12 does not apply if the solicitation includes the provisions at 52.214-16, Minimum Bid Acceptance Period.

12. In compliance with the above, the undersigned agrees, if this offer is accepted within _____ calendar days *(60 calendar days unless a different period is inserted by the offeror)* from the date for receipt of offers specified above, to furnish any or all items upon which prices are offered at the price set opposite each item, delivered at the designated point(s), within the time specified in the schedule.

13. DISCOUNT FOR PROMPT PAYMENT *(See Section I, Clause No. 52-232-8)* ▶	10 CALENDAR DAYS %	20 CALENDAR DAYS %	30 CALENDAR DAYS %	CALENDAR DAYS %

14. ACKNOWLEDGMENT OF AMENDMENTS *(The offeror acknowledges receipt of amendments to the SOLICITATION for offerors and related documents numbered and dated:*	AMENDMENT NO.	DATE	AMENDMENT NO.	DATE

15A. NAME AND ADDRESS OF OFFEROR	CODE	FACILITY	16. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*

15B. TELEPHONE NO. *(Include area code)*	15C. ☐ CHECK IF REMITTANCE ADDRESS IS DIFFERENT FROM ABOVE - ENTER SUCH ADDRESS IN SCHEDULE.	17. SIGNATURE	18. OFFER DATE

AWARD *(To be completed by Government)*

19. ACCEPTED AS TO ITEMS NUMBERED	20. AMOUNT	21. ACCOUNTING AND APPROPRIATION

22. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:
☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 253(c) ( )

23. SUBMIT INVOICES TO ADDRESS SHOWN IN ▶ ITEM
(4 copies unless otherwise specified)

24. ADMINISTERED BY *(If other than Item 7)* CODE	25. PAYMENT WILL BE MADE BY CODE

26. NAME OF CONTRACTING OFFICER *(Type or print)*	27. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	28. AWARD DATE

IMPORTANT - Award will be made on this Form, or on Standard Form 26, or by other authorized official written notice.

PART I - THE SCHEDULE
SECTION B
SUPPLIES OR SERVICES AND PRICES/COSTS

B-1 SUPPLIES OR SERVICES AND PRICES/COSTS

ITEM NUMBER	SUPPLIES OR SERVICES		QTY	UNIT	UNIT PRICE	AMOUNT
BASE YEAR						
					NOT-TO-EXCEED	
0001	The Contractor shall provide intellectual property services in accordance with Section C and with the rates set forth below.					**$400,000.00**
		Hourly Rate				
0001AA	Attorney < 2yrs Experience	$				
0001AB	Attorney ≥ 2yrs Experience	$				
0001AC	Attorney ≥ 4yrs Experience	$				
0001AD	Attorney ≥ 7yrs Experience	$				
0001AE	Non Attorney (Paralegal)	$				
0001AE	Travel					
0001AF	Material					
0002	Reports and Data in accordance with the Contract Data Requirements List (DD 1423), Exhibit A.		*NSP	*NSP		*NSP

NOTE (1): Oral presentations and other material will be used to evaluate and select the Contractor. See Sections L and M.

NOTE (2): The material line item will include such items as copying, mailing, electronic research and foreign filing fees. Patent and Trademark Office fees are paid by the Naval Research Laboratory.

NOTE (3): The Government intends to award multiple contracts from this solicitation. The Not-To-Exceed amount will be adjusted based on the number of awards made.

TOTAL NOT TO EXCEED $400,000.00

*Not Separately Priced

ITEM NUMBER	SUPPLIES OR SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
OPTION I					
					NOT-TO-EXCEED
0003	The Contractor shall provide intellectual property services in accordance with Section C and with the rates set forth below.				**$400,000.00**
				Hourly Rate	
0003AA	Attorney < 2yrs Experience			$	
0003AB	Attorney ≥ 2yrs Experience			$	
0003AC	Attorney ≥ 4yrs Experience			$	
0003AD	Attorney ≥ 7yrs Experience			$	
0001AE	Non Attorney (Paralegal)			$	
0003AG	Travel				
0003AH	Material				
0004	Reports and Data in accordance with the Contract Data Requirements List (DD 1423), Exhibit A.	*NSP		*NSP	*NSP
				TOTAL NOT TO EXCEED	**$400,000.00**

*Not Separately Priced

ITEM NUMBER	SUPPLIES OR SERVICES		QTY	UNIT	UNIT PRICE	AMOUNT
OPTION II						
						NOT-TO-EXCEED
0005	The Contractor shall provide intellectual property services in accordance with Section C and with the rates set forth below.					**$400,000.00**
		Hourly Rate				
0005AA	Attorney < 2yrs Experience	$				
0005AB	Attorney ≥ 2yrs Experience	$				
0005AC	Attorney ≥ 4yrs Experience	$				
0005AD	Attorney ≥ 7yrs Experience	$				
0001AE	Non Attorney (Paralegal)	$				
0005AF	Travel					
0005AG	Material					
0006	Reports and Data in accordance with the Contract Data Requirements List (DD 1423), Exhibit A.		*NSP		*NSP	*NSP
		TOTAL NOT TO EXCEED				**$400,000.00**

*Not Separately Priced

ITEM NUMBER	SUPPLIES OR SERVICES		QTY	UNIT	UNIT PRICE	AMOUNT
OPTION III						
						NOT-TO-EXCEED
0007	The Contractor shall provide intellectual property services in accordance with Section C and with the rates set forth below.					**$400,000.00**
		Hourly Rate				
0007AA	Attorney < 2yrs Experience	$				
0007AB	Attorney ≥ 2yrs Experience	$				
0007AC	Attorney ≥ 4yrs Experience	$				
0007AD	Attorney ≥ 7yrs Experience	$				
0001AE	Non Attorney (Paralegal)	$				
0007AF	Travel					
0007AG	Material					
0008	Reports and Data in accordance with the Contract Data Requirements List (DD 1423), Exhibit A.		*NSP		*NSP	*NSP
		TOTAL NOT TO EXCEED				**$400,000.00**

*Not Separately Priced

ITEM NUMBER	SUPPLIES OR SERVICES		QTY	UNIT	UNIT PRICE	AMOUNT
OPTION IV						
						NOT-TO-EXCEED
0009	The Contractor shall provide intellectual property services in accordance with Section C and with the rates set forth below.					**$400,000.00**
		Hourly Rate				
0009AA	Attorney < 2yrs Experience	$				
0009AB	Attorney ≥ 2yrs Experience	$				
0009AC	Attorney ≥ 4yrs Experience	$				
0009AD	Attorney ≥ 7yrs Experience	$				
0001AE	Non Attorney (Paralegal)	$				
0009AF	Travel					
0009AG	Material					
0010	Reports and Data in accordance with the Contract Data Requirements List (DD 1423), Exhibit A.		*NSP		*NSP	*NSP
				TOTAL NOT TO EXCEED		**$400,000.00**

*Not Separately Priced

TOTAL NOT-TO-EXCEED AMOUNT FOR ALL CLINS, IF EXERCISED: $2,000,000.00

SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

C-1 The work under this contract shall be performed in accordance with Attachment (1), Statement of Work, with Exhibit A, DD Form 1423, Contracts Data Requirements List, and all other Attachments cited in Section J, which are incorporated by reference into Section C.

SECTION D
PACKAGING AND MARKING

D-1 Preservation, packaging, packing and marking of all deliverable contract line items must conform to normal commercial packing standards to assure safe delivery at destination.

SECTION E
INSPECTION AND ACCEPTANCE

E-1 INSPECTION AND ACCEPTANCE CLAUSES BY REFERENCE:

FAR CLAUSE		TITLE
52.246-6	-	Inspection - Time-And-Material And Labor-Hour (JAN 1986)
52.246-16	-	Responsibility For Supplies (APR 1984)

DFARS CLAUSE		TITLE
252.246-7000	-	Material Inspection And Receiving Report (DEC 1991)

E-2 INSPECTION AND ACCEPTANCE

Inspection and acceptance of the final delivery will be accomplished by the Technical Manager (TM) or Contracting Officer Representative (COR) designated in Section G of this contract . Inspection and acceptance will be performed at the Naval Research Laboratory, Washington DC 20375-5320.

SECTION F
DELIVERIES OR PERFORMANCE

F-1 DELIVERIES OR PERFORMANCE CLAUSES BY REFERENCE:

FAR CLAUSE		TITLE
52.242-15	-	Stop-Work Order (AUG 1989)
52.242-17	-	Government Delay Of Work (APR 1984)
52.247-34	-	F.O.B. Destination (NOV 1991)

F-2 DELIVERIES OR PERFORMANCE

The period of performance under this contract shall be from date of award through twelve (12) months. If the time allowed for completion of a work assignment extends beyond the current term of the contract, the current term of the contract shall be extended to the end of the time allowed for completion of the assignment. Each option, if exercised, shall have a period of performance from date of award of option through twelve (12) months, thereafter.

SECTION G
CONTRACT ADMINISTRATION DATA

G-1 PROCURING OFFICE REPRESENTATIVE

In order to expedite administration of the contract, the Administrative Contracting Officer (ACO) will direct inquiries to the appropriate office listed below. Please do not direct routine inquiries to the person listed in Item 20A on Standard Form 26.

Contract Matters- *

Security Matters- *

Safety Matters- *

Patent Matters- *

Release of Data- *

The ACO will forward invention disclosures and reports directly to the Associate Counsel for Patents, Code 1008.2, Naval Research Laboratory, Washington DC 20375-5320. The Associate Counsel for Patents will return the reports along with a recommendation to the Administrative Contracting Officer. The Associate Counsel for Patents will represent the Contracting Officer with regard to invention reporting matters arising under this contract.

(* To be filled in at time of award)

G-2 CONTRACTING OFFICER'S REPRESENTATIVE (COR) - FUNCTIONS AND LIMITATIONS

* is hereby designated the cognizant COR who will represent the Contracting Officer in the assignment of work and administration of technical details within the scope of this contract and inspection and acceptance. The COR is not otherwise authorized to make any representations or commitments of any kind on behalf of the Contracting Officer or the Government. The COR does not have the authority to alter the Contractor's obligations or change the specifications in the contract. If, as a result of technical discussions, it is desirable to alter contract obligations or statements of work, a modification must be issued in writing and signed by the Contracting Officer. The COR is responsible for reviewing the bills and charges submitted by the Contractor and informing the ACO of areas where exceptions are to be taken.

(* To be filled in at time of award)

G-3 ONR 5252.242-9718 - TECHNICAL DIRECTION (DEC 88)

(a) Performance of the work hereunder is subject to the technical direction of the Scientific Officer/COR designated in this contract or his duly authorized representative. For the purposes of this clause, technical direction includes the following:

(1) Direction to the Contractor which shifts work emphasis between work areas or tasks, requires pursuit of certain lines of inquiry, fills in details or otherwise serves to accomplish the objectives described in the statement of work;

(2) Guidelines to the Contractor which assist in the interpretation of drawings, specifications or technical portions of work description.

(b) Technical direction must be within the general scope of work stated in the contract. Technical instructions may not be used to:

(1) Assign additional work under the contract

(2) Direct a change as defined in the contract clause entitled "Changes";

(3) Increase or decrease the estimated contract cost, the fixed fee, or the time required for contract performance; or

(4) Change any of the terms, conditions or specifications of the contract.

(c) The only individual authorized to in any way amend or modify any of the terms of this contract shall be the Contracting Officer. When, in the opinion of the Contractor, any technical instruction calls for effort outside the scope of the contract or inconsistent with this special provision, the Contractor shall notify the Contracting Officer in writing within ten working days after its receipt. The Contractor shall not proceed with the work affected by the technical direction until the Contractor is notified by the Contracting Officer that the technical direction is within the scope of the contract.

(d) Nothing in the foregoing paragraphs may be construed to excuse the Contractor from performing that portion of work statement which is not affected by the disputed technical instruction.

G-4 NAPS 5252.232-9001 - SUBMISSION OF INVOICES (COST-REIMBURSEMENT, TIME-AND-MATERIALS, LABOR-HOUR, OR FIXED PRICE INCENTIVE (JUL 1992)

(a) "Invoice" as used in this clause includes contractor requests for interim payments using public vouchers (SF 1034) but does not include contractor requests for progress payments under fixed price incentive contracts.

(b) The Contractor shall submit invoices and any necessary supporting documentation, in an original and 4 copies, to the contract auditor at the following address:

(To be filled in at time of award)

unless delivery orders are applicable, in which case invoices will be segregated by individual order and submitted to the address specified in the order. In addition, an information copy shall be submitted to [See Section G for designated COR]. Following verification, the contract auditor will forward the invoice to the designated payment office for payment in the amount determined to be owing, in accordance with the applicable payment (and fee) clause(s) of this contract.

(c) Invoices requesting interim payments shall be submitted no more than once every two weeks, unless another time period is specified in the Payments clause of this contract. For indefinite delivery type contracts, interim payment invoices shall be submitted no more than once every two weeks for each delivery orders. There shall be a lapse of no more than 10 calendar days between performance and submission of an interim payment invoice.

(d) In addition to the information identified in the Prompt Payment clause herein, each invoice shall contain the following information, as applicable:

(1) Contract line item number (CLIN)
(2) Subline item number (SLIN)
(3) Accounting Classification Reference Number(ACRN)
(4) Payment terms
(5) Procuring activity
(6) Date supplies provided or services performed
(7) Costs incurred and allowable under the contract
(8) Vessel (e.g., ship, submarine or other craft) or system for which supply/service is provided

(e) A DD Form 250, "Material Inspection and Receiving Report",

** is required with each invoice submittal.
** is required only with the final invoice.
** is not required.

(f) A Certificate of Performance

** shall be provided with each invoice submittal.
** is not required.

(g) The Contractor's final invoice shall be identified as such, and shall list all other invoices (if any) previously tendered under this contract.
(h) Cost of performance shall be segregated, accumulated and invoiced to the appropriate ACRN categories to the extent possible. When such segregation of costs by ACRN is not possible for invoices submitted with CLIN/SLINS with more than one ACRN, an allocation ratio shall be established in the same ratio as the obligations cited in the accounting data so that costs are allocated on a proportional basis.
Alternate I (JUL 1992).
(i) When a vendor invoice for a foreign currency is provided as supporting documentation, the Contractor shall identify the foreign currency and indicate on the vendor invoice the rate of exchange on the date of payment by the Contractor. The Contractor shall also attach a copy of the bank draft or other suitable documents showing the rate of exchange. The contractor shall provide an English translation if the vendor invoice is written in a foreign language.

G-5 CONTRACT CEILING PRICE

(a) The amount of $ * is presently available for payment and allotted to this contract. This amount is the ceiling price that the contractor shall not exceed except at its own risk. It is estimated that this amount is sufficient for performance of the contract through *.
(b) The not-to-exceed price stated in Section B is the Government's estimate of the price of the maximum labor and materials required to perform this contract. The parties contemplate that the Government will allot additional funds incrementally to the contract up to the full not-to-exceed amount or to a lesser amount necessary to perform the contract.
(c) The Contractor agrees to perform up to the point at which the total amount payable by the Government, including reimbursement in the event of termination for the Government's convenience, approximates the total amount currently allotted to the contract. The Contractor will not be obligated to continue work beyond that point. The Government will not be obligated in any event to reimburse the Contractor in excess of the amount allotted to the contract regardless of anything to the contrary in any other clause or provision of this contract.

(d) The Contractor shall notify the Contracting Officer in writing at least sixty days prior to the date when, in the Contractor's best judgment, the work under the contract will reach the point at which the total amount payable by the Government, including any cost for termination for convenience, will approximate the total amount then allotted to the contract. The notification will state (1) the estimated date when that point will be reached and (2) an estimate of additional funding, if any, needed to continue performance through the current period of performance or to a mutually agreed upon substitute date. If after such notification additional funds are not allotted by the date identified in the Contractor's notification, or by an agreed substitute date, the Contracting Officer, upon the Contractor's written request, will terminate the contract on that date in accordance with the provisions of the Termination clause of this contract.
(e) If, solely by reason of failure of the Government to allot additional funds in amounts sufficient for timely performance of the contract, the Contractor incurs additional costs or is delayed in the performance of the work under this contract and if additional funds are allotted, an equitable adjustment will be made in the price or in the period of performance, or both. Failure to agree to any such equitable adjustment hereunder will be a dispute concerning a question of fact within the meaning of the clause entitled "Disputes."
(f) The Government may at any time prior to termination allot additional funds for the performance of the contract.
(g) Nothing in this clause affects the rights of the Government to terminate this contract pursuant to other clauses or provisions of this contract.

(* To be filled in at time of award)

SECTION H
SPECIAL CONTRACT REQUIREMENTS

H-1 TYPE OF CONTRACT*

(* To be filled in at time of award)

H-2 YEAR 2000 COMPLIANT INFORMATION TECHNOLOGY

This requirement applies to information technology (IT) that processes date-related information. All such IT delivered under this contract shall be Year 2000 compliant as defined at FAR 39.002.

H-3 REPRESENTATIONS AND CERTIFICATIONS

The Contractor's completed Representations, Certifications, and Other Statements of Offerors or Respondents is incorporated herein by reference in any resultant award.

H-4 ONR 5252.237-9705 - KEY PERSONNEL (DEC 88)

(a) The Contractor agrees to assign to the contract tasks those persons whose resumes were submitted with its proposal and who are necessary to fulfill the requirements of the contract as "key personnel". No substitutions may be made except in accordance with this clause.
(b) The Contractor understands that during the first ninety-(90) days of the contract performance period, no personnel substitutions will be permitted unless these substitutions are unavoidable because of the incumbent's sudden illness, death or termination of employment. In any of these events, the Contractor shall promptly notify the Contracting Officer and provide the information described in paragraph (c) below. After the initial ninety (90) day period the Contractor must submit to the Contracting Officer all proposed substitutions, in writing, at least fifteen (15) days in advance (thirty (30) days if security clearance must be obtained) of any proposed substitution and provide the information required by paragraph (c) below.
(c) Any request for substitution must include a detailed explanation of the circumstances necessitating the proposed substitution, a resume for the proposed substitute, and any other information requested by the Contracting Officer. Any proposed substitute must have qualifications equal to or superior to the qualifications of the incumbent. The Contracting Officer or his/her authorized representative will evaluate such requests and promptly notify the Contractor of his/her approval or disapproval thereof.
(d) In the event that any of the identified key personnel cease to perform under the contract and the substitute is disapproved, the contract may be immediately terminated in accordance with the Termination clause of the contract.
The following are identified as key personnel:

(To be filled in at time of award)

H-5 OPTION TO EXTEND SERVICES

The Government may require continued performance of any services within the limits and at the rates specified in the contract. The Contracting Officer may exercise the option by written notice to the Contractor .

PART II - CONTRACT CLAUSES
SECTION I
CONTRACT CLAUSES

I-1 52.252-2 - CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at this/these address(es): http://www.arnet.gov/far and http://heron.nrl.navy.mil/contracts/home.htm

a. FEDERAL ACQUISITION REGULATION CLAUSES

FAR CLAUSE		TITLE
52.202-1	-	Definitions (OCT 1995)
52.203-3	-	Gratuities (APR 1984)
52.203-5	-	Covenant Against Contingent Fees (APR 1984)
52.203-7	-	Anti-Kickback Procedures (JUL 1995)
52.203-8	-	Cancellation, Rescission, And Recovery Of Funds For Illegal Or Improper Activity (JAN 1997)
52.203-10	-	Price Or Fee Adjustment For Illegal Or Improper Activity (JAN 1997)
52.203-12	-	Limitation On Payments To Influence Certain Federal Transactions (JUN 1997)
52.204-4	-	Printing/Copying Double-Sided On Recycled Paper (JUN 1996)
52.209-6	-	Protecting The Government's Interest When Subcontracting With Contractors Debarred, Suspended, Or Proposed For Debarment (JUL 1995)
52.211-15	-	Defense Priority and Allocation Requirements (SEP 1990)
52.215-2	-	Audit And Records-Negotiation (JUNE 1999)
52.215-8	-	Order of Precedence - Uniform Contract Format (OCT 1997)
52.215-14	-	Integrity of Unit Prices (OCT 1997)
52.215-17	-	Waiver of Facilities Capital Cost of Money (OCT 1997) (*will be included if the successful offeror does not propose facilities capital cost of money)*
52.215-21	-	Requirements for Cost and Pricing Data or Information Other Than Cost or Pricing Data - Modifications (OCT 1997) - Alternate IV (OCT 1997)
52.217-8	-	Option To Extend Services (NOV 1999)

52.219-4 - Notice of Price Evaluation Preference For HUBZone Small Business Concerns (JAN 1999) ☐ Offeror elects to waive the evaluation preference.
52.219-8 - Utilization Of Small Business Concerns (OCT 1999)
52.219-9 - Small Business Subcontracting Plan (JAN 1999)
52.219-16 - Liquidated Damages - Subcontracting Plan (JAN 1999)
52.219-25 - Small Disadvantaged Business Participation Program-Disadvantaged Status And Reporting (OCT 1999)
52.222-1 - Notice To The Government Of Labor Disputes (FEB 1997)
52.222-3 - Convict Labor (AUG 1996)
52.222-21 - Prohibition of Segregated Facilities (FEB 1999)
52.222-26 - Equal Opportunity (FEB 1999)
52.222-35 - Affirmative Action For Disabled Veterans And Veterans Of The Vietnam Era (APR 1998)
52.222-36 - Affirmative Action For Workers With Disabilities (JUN 1998)
52.222-37 - Employment Reports On Disabled Veterans And Veterans Of The Vietnam Era (JAN 1999)
52.223-6 - Drug-Free Workplace (JAN 1997)
52.223-14 - Toxic Chemical Release Reporting (OCT 1996)
52.225-13 - Restrictions On Certain Foreign Purchases (FEB 2000)
52.226-1 - Utilization Of Indian Organizations And Indian-Owned Economic Enterprises (FEB 2000)
52.227-1 - Authorization And Consent (JUL 1995)
52.227-2 - Notice And Assistance Regarding Patent And Copyright Infringement (AUG 1996)
52.229-3 - Federal, State, And Local Taxes (JAN 1991)
52.229-5 - Taxes - Contracts Performed In U.S. Possessions Or Puerto Rico (APR 1984)
52.230-2 - Cost Accounting Standards (APR 1998)
52.230-3 - Disclosure And Consistency Of Cost Accounting Practices (APR 1998)
52.230-6 - Administration Of Cost Accounting Standards (NOV 1999)
52.232-7 - Payments Under Time-And-Materials And Labor-Hour Contracts (MAR 2000)
52.232-9 - Limitation On Withholding Of Payments (APR 1984)
52.232-17 - Interest (JUN 1996)
52.232-18 - Availability Of Funds (APR 1984)
52.232-23 - Assignment Of Claims (JAN 1986)
52.232-25 - Prompt Payment (JUN 1997)
52.232-33 - Payment By Electronic Funds Transfer-Central Contractor Registration (MAY 1999)
52.233-1 - Disputes (DEC 1998)
52.233-3 - Protest After Award (AUG 1996)
52.237-10 - Identification of Uncompensated Overtime (OCT 1997)
52.242-13 - Bankruptcy (JUL 1995)

52.243-3 - Changes--Time-And-Materials Or Labor-Hours (AUG 1987)
52.245-1 - Property Records (APR 1984)
52.249-6 - Termination (Cost - Reimbursement) (SEP 1996) Alternate IV (SEP 1996)
52.249-14 - Excusable Delays (APR 1984)
52.251-1 - Government Supply Sources (APR 1984)
52.253-1 - Computer Generated Forms (JAN 1991)

DFARS CLAUSE TITLE

252.201-7000 - Contracting Officer's Representative (DEC 1991)
252.203-7001 - Prohibition On Persons Convicted Of Fraud Or Other Defense Contract Related Felonies (MAR 1999)
252.204-7003 - Control Of Government Personnel Work Product (APR 1992)
252.204-7004 - Required Central Contractor Registration (MAR 2000)
252.205-7000 - Provision Of Information To Cooperative Agreement Holders (DEC 1991)
252.209-7000 - Acquisition From Subcontractors Subject To On-Site Inspection Under The Intermediate-Range Nuclear Forces (INF) Treaty (NOV 1995)
252.209-7004 - Subcontracting With Firms That Are Owned Or Controlled By The Government Of A Terrorist Country (MAR 1998)
252.219-7003 - Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan (DoD Contracts) (APR 1996)
252.219-7004 - Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan (Test Program) (JUN 1997)
252.225-7012 - Preference for Certain Domestic Commodities (MAY 1999)
252.225-7025 - Restriction On Acquisition Of Forgings (JUN 1997)
252.225-7031 - Secondary Arab Boycott Of Israel (JUN 1992)
252.225-7043 - Antiterrorism/Force Protection Policy For Defense Contractors Outside The United States (JUN 1998) (fill in : Naval Criminal Investigative Service (NCIS), Code 24, telephone, DSN 228-9113 or commercial (202)433-9113)
252.231-7000 - Supplemental Cost Principles (DEC 1991)
252.233-7000 - Certification Of Claims And Requests For Adjustment Or Relief (MAY 1994)
252.242-7000 - Postaward Conference (DEC 1991)
252.243-7001 - Pricing Of Contract Modifications (DEC 1991)
252.243-7002 - Requests for Equitable Adjustment (MAR 1998)
252.244-7000 - Subcontracts For Commercial Items And Commercial Components (DOD Contracts) (MAR 2000)
252.245-7001 - Reports of Government Property (MAY 1994)
252.247-7023 - Transportation Of Supplies By Sea (MAR 2000)

252.247-7024 - Notification Of Transportation Of Supplies By Sea (MAR 2000) *(will be included if the successful offeror made a negative response to the inquiry at DFARS 252.247-7022)*
252.251-7000 - Ordering From Government Supply Sources (MAY 1995)

I-2 FAR 52.223-11 - OZONE-DEPLETING SUBSTANCES (JUN 1996)

(a) Definitions.
"Ozone-depleting substance", as used in this clause, means any substance designated as Class I by the Environmental Protection Agency (EPA) (40 CFR Part 82), including but not limited to chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform; or any substance designated as Class II by EPA (40 CFR Part 82), including but not limited to hydrochlorofluorocarbons.

(b) The Contractor shall label products which contain or are manufactured with ozone-depleting substances in the manner and to the extent required by 42 U.S.C. 7671j (b), (c), and (d) and 40 CFR Part 82, Subpart E, as follows:
"WARNING: Contains (or manufactured with, if applicable)_____*_____, a substance(s) which harm(s) public health and environment by destroying ozone in the upper atmosphere."
* The Contractor shall insert the name of the substance(s).

PART III - LIST OF DOCUMENTS, EXHIBITS, AND OTHER ATTACHMENTS
SECTION J
LIST OF ATTACHMENTS

J-1 Attachment (1) - Statement of Work – 3 Pages, with Exhibit A - DD Form 1423, Contract Data Requirements – 1 Page.

J-2 Attachment (2) – Offerors Available Support 1 – Page.

J-3 Attachment (3) – Sample Chemical Patent Disclosure – 4 Pages.

J-4 Attachment (4) – Sample Electronics Patent Disclosure – 13 Pages.

J-5 Attachment (5) – Accounting and Appropriation Data. – 1 Page (Attached at time of award).

PART IV - REPRESENTATIONS AND INSTRUCTIONS
SECTION K
REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS OR RESPONDENTS

K-1 Representations, Certifications, and Other Statements of Offerors or Respondents

Each Offeror must submit a completed Representations, Certifications, and Other Statements Of Offerors or Respondents with its proposal which is available electronically in full text at http://heron.nrl.navy.mil/contracts/reps&certs.htm

K-2 FILL IN FOR FAR 52.219-1 - SMALL BUSINESS PROGRAM REPRESENTATIONS (MAY 1999)

The fill in information is as follows:
The standard industrial classification (SIC) code for this acquisition is 8111.
The small business size standard is $5.0 million.

SECTION L
INSTRUCTIONS, CONDITIONS, AND NOTICES TO OFFERORS OR RESPONDENTS

L-1 52.252-1 SOLICITATION PROVISIONS INCORPORATED BY REFERENCE (FEB 1998)

This solicitation incorporates one or more solicitation provisions by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. The offeror is cautioned that the listed provisions may include blocks that must be completed by the offeror and submitted with its quotation or offer. In lieu of submitting the full text of those provisions, the offeror may identify the provision by paragraph identifier and provide the appropriate information with its quotation or offer. Also, the full text of a solicitation provision may be accessed electronically at this/these address(es):

http://www.arnet.gov/far
http://heron.nrl.navy.mil/contracts/home.htm

FAR CLAUSE		TITLE
52.204-6	-	Data Universal Numbering System (DUNS) Number (JUNE 1999)

52.215-1 - Instructions to Offerors- Competitive Acquisition (FEB 2000)
52.215-16 - Facilities Capital Cost Of Money (OCT 1997)
52.219-24 - Small Disadvantaged Business Participation Program - Targets (JAN 1999)

L-2 FAR 52.211-14 - NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990)

Any contract awarded as a result of this solicitation will be a ☐ DX rated order; ☒ DO rated order certified for national use under the Defense Priorities and Allocations system (DPAS) (15 CFR 700), and the Contractor will be required to follow all of the requirements of this regulation.

L-3 FAR 52.215-20 REQUIREMENTS FOR COST OR PRICING DATA OR INFORMATION OTHER THAN COST OR PRICING DATA (OCT 1997)ALTERNATE IV (OCT 1997)

(a) Submission of cost or pricing data is not required.
(b) Provide information described below : See L-9.
Offerors should provide information to enable the Contracting Officer to determine that the proposed price is fair and reasonable. Such information could include published price lists, information on previous sales of the same of similar items, or the projected costs of fabricating and installing the item (material costs, labor costs, etc).

L-4 FAR 52.216-1 - TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a Time and Material Type contract resulting from this solicitation.

L-5 FAR 52.233-2 - SERVICE OF PROTEST (AUG 1996)

(a) Protests, as defined in Section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO) shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from the Control Desk, Code 3200, Bldg. 222, Rm. 115, Naval Research Laboratory, 4555 Overlook Ave., S.W., Washington DC 20375-5326.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

L-6 GOVERNMENT-FURNISHED PROPERTY

No material, labor, or facilities will be furnished by the Government unless provided for in the solicitation.

L-7 INQUIRIES CONCERNING THE RFP

Any questions concerning the RFP must be submitted in writing to the Contracting Officer at the location noted in blocks 7 and 9 of the Standard Form 33, "Solicitation, Offer and Award," no less than fifteen (15) days before closing. The Government will not consider questions received after this date. Offerors are cautioned against directing any questions concerning this RFP to technical personnel at the Naval Research Laboratory.

L-8 INSTRUCTIONS FOR SUBMISSION AND INFORMATION REQUIRED TO EVALUATE

Technical proposals will be presented to the Government in oral form by means of an oral presentation. The presentation process will be conducted at the Naval Research Laboratory. The specific technical evaluation criteria, which must be addressed in the oral presentation, are set forth in paragraph (b). Unnecessarily elaborate brochures or other presentations beyond those sufficient to present a complete and effective response to this solicitation are not desired and may be construed as an indication of the offeror's lack of cost consciousness.

(a) The following information must be submitted in writing: (1 ORIGINAL COPY AND 3 COPIES)

(1) Standard Form 33, "Solicitation, Offer, and Award" with blocks 12 through 18 completed by the Offeror.

(2) A completed Representations, Certifications, and Other Statements of Offeror, that the Offeror has completed which is available electronically in full text at http://heron.nrl.navy.mil/contracts/reps&certs.htm

(3)Other Materials: These materials shall be bound separately from the above written materials. The Offeror shall provide four copies of the following material in loose-leaf, or other style, binders – one binder per copy, one copy per binder – so that the pages lay flat when opened. The pages shall be standard 8½" x 11" stock. Pages that are in landscape format shall be bound so that the pages' bottom edges face right when the binder is opened. The Offeror shall also submit in a sealed envelope the copy of its presentation materials that will be provided to the presenter to use for his presentation.

(a) Firm Brochure: The Offeror is permitted, but not required, to include a copy of one brochure that it normally provides to prospective clients.

(b) Resumes: The Offeror shall provide a resume for each in-house attorney whose experience or expertise was included in completing Attachment (2), Offeror's Available Support. The Offeror shall sequentially number its resumes and use those numbers in completing Attachment (2). Resumes for individuals who are "of Counsel" and other outside individuals may be included but are not required. Offerors may only include the experience or expertise of such outside individuals if the Offeror has an established, on-going relationship with them.

(c) Offeror's Available Support: The Offeror shall indicate the technologies in which it has experience and expertise by completing Attachment (2), Offeror's Available Support. Under patent preparation, staff, the Offeror should enter the numbers of the applicable resumes. The Offeror may complete the other table entries by check-marking the applicable boxes.

(d) Sample estimate: Attachments (3), a sample chemical patent disclosure and Attachment (4), a sample electronics patent disclosure are provided. The Offeror shall select one of the two sample disclosures and provide an estimate of the labor hours, by attorney experience, necessary to provide the patentability report, draft application, IDS, and informal drawings for that sample disclosure.

(e) Presentation Materials: The Offeror shall not use any media or material during its presentation other than material that it provided responsive to "Presentation Materials." The offeror's presenter may speak from a bound copy of the materials or use overhead transparency copies. The presentation materials are limited to 20 pages or transparencies (This page limit only applies to "Presentation Materials"). The pages or transparencies must be:

(1) Sequentially numbered
(2) In black and white
(3) Limited to key points of the offeror's presentation
(4) In bullet format, and
(5) Limited to a header and no more than 8 bullets or sub-bullets.

(b) The following instructions pertain to the oral presentations.

(1) Schedule of Presentation: Presentations will be scheduled with offerors 5 days after closing date of the solicitation. The presentations will be scheduled as tightly as possible, but the duration of the oral presentation process will be dependent upon the number of offers received. The order in which offerors will make their presentations to the government will be determined by a drawing of lots by the contracting officer after receipt of proposals. Once notified of their scheduled presentation date and time, offerors shall complete their presentations on the scheduled date and time. Requests from offerors to reschedule their presentations will

not be entertained and no rescheduling of presentations will be done unless determined necessary by the Government to resolve unanticipated problems or delays encountered in the presentation process.

(2) Facility: The Offerors shall present at NRL, Building 222, Room115. The Offerors' representatives should allow 15 minutes to check in and locate the presentation room. NRL is a secure facility and must abide by the following:

(a) One form of identification will be required (driver's license)
(b) No cameras, tape recorders, or other reproduction devices will be allowed.
(c) The Government Security reserves the right to inspect all material, briefcases, etc. when entering or leaving the Government facilities.

(3) Attendees: Two individuals representing the Contracting Officer, and the three members of NRL's Technical Evaluation Team shall attend the presentation. The Offeror may have up to four individuals, including the presenter, attend the presentation.

(4) Material and Equipment. The Contracting Officer will provide the offeror's Presentation Material submitted with the proposal, an overhead projector, screen, and transparency pens for the Offerors' use during their presentations. The offerors shall not use any other media or materials during their presentations.

(5) Time Allowed for Presentations. Each offeror's representative will have a maximum of one hour in which to present the offeror's capabilities to provide NRL's intellectual property services.

(6) Record: The Offerors' "Presentation Material" submissions shall be NRL's record of the presentation. The Offeror may only present slides that it submitted with its proposal; the Contracting Officer will only retain in the record and consider those slides that the Offeror projected or expressly discussed during its presentation. A sheet will be made available for signatures and position titles of all representatives of the company.

(7) Communications: Immediately following the offeror's presentations, NRL's representatives may ask the Offeror to clarify a statement. Any such interchange between the offeror and the Government will be for clarification only, and will not constitute discussions within the meaning defined in the Federal Acquisition Regulations. Offerors will not be permitted to amend their proposals in response to clarifications during the presentations. The time required for clarifications will not be counted against the offeror's 1-hour time limit.

(c) The following information pertains to the content of the oral presentations. During the presentation, the Offerors must address the following topics in the order in which they are listed below. The Offeror may allocate its time among these topics as it sees fit. NRL reminds the Offerors that their price and fees may *NOT* be discussed during the presentation. The Proposal should clearly and fully demonstrate the offeror's capabilities, knowledge, and related experience to perform the types of work described in the Statement of Work. NRL intends the oral presentation to allow an easy method by which the Offerors may establish their capabilities to satisfy NRL's requirements. Although mandatory, the content of the presentation will not become a part of any contract resulting from this solicitation.

(1) Exceptions: Consistent with M-1 Evaluation that bars award without discussions to an Offeror that takes exception to the solicitation's terms and conditions, the offeror shall expressly identify each exception that it takes to the Solicitation's terms and conditions.

(2) Past Performance: List the last 5 contracts or subcontracts completed during the past 3 years for services similar in nature to this requirement. Include in the 5 any current contracts or subcontracts for similar services that were awarded at least one year prior to the date of this solicitation. Offerors that have no similar previous or current contracts should provide the requested information for proposed subcontractors that will perform major or critical aspects of the requirement. Offerors should expressly address whether the service was provided on time, within budget, and whether the service satisfied the other party's need. The list must included the following information:

a. Name of contracting organization.
b. Contract number
c. Contract type
d. Total contract value
e. Description of the contract work
f. Contracting officer and telephone number
g. Contracting officer's representative, program manager, or similar official and telephone number

(3) Software programs: The Offeror shall address whether its staff works in the WordPerfect and ChemWindow formats (in which the Offeror must deliver the documents) or whether it will convert documents from other formats. If the Offeror plans to convert formats, the Offeror should address its experiences with the required conversions.

(4) Staffing: The Offeror shall address its total staffing and support and the level of services that it could provide NRL without adversely affecting its timeliness or quality.

(5) Travel: The Offeror shall address how the personnel that it assigns to NRL's efforts will communicate with the inventors and the amount of local and remote travel that it anticipates in doing so.

(6) Quality: The Offeror shall address its *normal*, internal reviews and other mechanisms by which it monitors and controls the quality of its delivered products. The Offeror shall also address any additional controls that it will apply to NRL's disclosures to ensure that its draft applications adequately protect NRL's invention without needing significant comments or efforts from NRL's staff attorneys.

(7) Foreign Filings: The Offeror shall address its ability to obtain foreign services to translate, file, and prosecute foreign, national applications. The offeror shall also address how it will bill these services and any existing relationships for filings in Britain, Germany, Canada, Japan, and South Korea.

(8) Timeliness: The Offeror shall address its ability to timely deliver products and any internal mechanisms by which it ensures that its products are timely delivered.

(9) Other items: The Offeror may address information, *not* requested within the written materials or oral presentation, which the Offeror believes significantly relates to its ability to provide the requested service.

L-9 BUSINESS PROPOSAL

REQUIRED COPIES: 1 ORIGINAL AND 3 COPIES

(1) PRICE PROPOSAL

The offeror shall submit a business proposal that includes a price proposal with supporting information . The supporting breakdown should include such elements as materials, direct labor, indirect cost, and other costs such as travel. The offeror shall provide exhibits as necessary to substantiate the price

(2) SMALL BUSINESS PARTICIPATION

(a) In addition to complying with the clause at FAR 52.219-9, Small Business Subcontracting Plan (Jan 1999) with its Alternate II, proposals must include information to permit evaluation of the extent of participation of small businesses and historical black colleges or universities and minority institutions in performance of the contract. Participation to be identified may be in the form of a joint venture, teaming arrangement, or subcontract. Small business concerns that are not required by FAR 52.219-9 to submit a subcontracting plan must indicate the extent to, which proposed joint ventures, teaming arrangements, or subcontracts are with historically black colleges or universities and minority institutions. Information provided should include the extent of participation of such firms in terms of the value of the total acquisition and the complexity and variety of the work such firms are to perform.

(b) Proposals must also include information to permit evaluation of the extent of participation of small disadvantaged business concerns in performance of the contract. See the provision at FAR 52.219-24, Small Disadvantaged Business Participation Program--Targets (Jan 1999), and the clause at 52.219-25, Small Disadvantaged Business Participation Program--Disadvantaged Status and Reporting (Jan 1999). Any targets will be incorporated into and become part of any resulting contract. Information provided should include the extent of participation of such firms in terms of the value of the total acquisition and the complexity and variety of the work such firms are to perform.

L-10 MULTIPLE AWARDS

The Government intends to award multiple contracts from this solicitation.

SECTION M
EVALUATION FACTORS FOR AWARD

M-1 EVALUATION

Award will be made to those acceptable offers that represent the best value to the Government based on the offeror's capability and their price. For the purpose of the best value analysis, the Contracting Officer will calculate the offeror's price by applying its schedule of prices to NRL's estimate of the effort necessary to complete a sample patent application.

M-2 EVALUATION FACTORS FOR AWARD

Each offer's acceptability will be determined on a pass-fail basis. To be determined acceptable for an offer must include all the material identified in Section L and manifest the offeror's acceptance, with out exceptions, to the solicitation's terms and conditions. All acceptable offers will be evaluated against the factors in M-2-1. The technical factor is more important than the price factor. Technical factor 1, is more important than factors 2 through 8. Technical factors 2 and 3 are of equal importance and more important than factors 4 through 8. Technical factors 4 through 8 are of equal importance. Where applicable, the principle source of the information to be utilized is indicated in parentheses after each factor.

M-2-1. TECHNICAL EVALUATION FACTORS OF ORAL PRESENTATIONS AND OTHER MATERIAL

(1) Quality: The offeror's ability to provide a quality product that protects NRL's inventions and that does not require significant comments or rework from NRL's attorney staff (oral presentation).

(2) Staff experience: The experience of the individuals for whom the Offeror provided resumes (resumes).

(3) Staff background: The technical background of the individuals for whom the Offeror provided resumes (resumes);

(4) Ability to Support foreign filings: The ability to provide, coordinate, and manage foreign patent applications, translations, and prosecution.

(5) Breadth of available support. The breadth of identified technologies for which that the Offeror can provide support (Attachment 2).

(6) Timeliness: The offeror's ability to timely provide the required deliverables (oral presentation).

(7) Past Performance: Past performance will be evaluated on the basis of the quality of the work performed or supplies delivered and timeliness of performance or delivery. The evaluation will be based on the information provided pursuant to Section L and other sources if available. Offerors that have no relevant performance history or for which past performance information is not available will not be evaluated favorably or unfavorably on past performance. The government may begin proposal evaluation prior to receipt of past performance information. If, after completion of proposal evaluation except evaluation of past performance, the contracting officer determines that evaluation of past performance will not affect the outcome of competitive selection, the contracting officer may waive its evaluation in accordance with FAR 15.304(c)(3)(iii).

(8) Word processing programs: The offeror's ability to provide its product in the file formats required in Attachment (1), Statement of Work. (oral presentations)

M-2-2 PRICE TO THE GOVERNMENT

Proposed estimated price to the Government.

M-2-3 SMALL BUSINESS PARTICIPATION

(a) The extent of participation of small businesses and historically black colleges or universities and minority institutions in performance of the contract will be evaluated on the basis of the proposed extent of participation of such firms in terms of the value of the total acquisition and the complexity and variety of the work such firms are to perform.

(b) The extent of participation of small disadvantaged business concerns in performance of the contract will be evaluated on the basis of the proposed extent of participation of such firms in terms of the value of the total acquisition and the complexity and variety of the work such firms are to perform.

M-3 FAR 52.217-5 - EVALUATION OF OPTIONS (JUL 1990)

Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

STATEMENT OF WORK

1.0 BACKGROUND:

The Naval Research Laboratory (NRL), located in Washington D.C., and other sites, conducts basic and applied research in many technical areas to support the Navy's military missions. NRL applies for U.S. and foreign patent rights for some of the technology developed by its employees, and NRL's technology transfer program seeks to license those patents to commercial ventures. NRL's patents include the areas of Undersea Acoustics; Chemical/Biochemical; Electronics and Electromagnetics; Energetic Particles, Plasmas and Beams; Information Technology and Communication; Materials Science and Technology; Ocean and Atmospheric Science and Technology; Optical Science; Remote Sensing; Simulation, Computing, and Modeling; and, Space Research and Satellite Technology. Information about NRL research and technology areas may be found at the NRL website http//www.nrl.navy.mil.

2.0 Scope:

The Contractor shall provide a full range of intellectual property services. The significant majority of the assigned work will be in drafting patentability reports and patent applications for filing with the U. S. Patent and Trademark Office (USPTO), including both U.S. patent applications and patent applications filed under the Patent Cooperation Treaty. The Contractor's services will be performed in support of the NRL Intellectual Property Counsel in response to work assignments communicated to it by the Contracting Officer's Representative (COR). Work assignments will be determined by the needs of the NRL Intellectual Property Counsel based upon the quantity of workload and requirements in technology areas for which NRL does not maintain specialized in-house expertise.

3.0 Requirements:

3.1.0 Patentability Reports:

3.1.1 NRL will provide to the contractor the invention disclosure and any related materials. Upon receipt of the invention disclosure, the contractor shall: review the invention disclosure and conduct a patentability search of US patents and worldwide publications, and report the results to NRL, within ten working days, with an estimate of the effort and cost to prepare a patent application. The Contractor must get the COR's approval before exceeding 125% of its cost estimate.

3.1.2 If NRL elects not to patent the disclosed invention, the contractor shall submit an invoice accounting for the hours billed.

3.2.0 Patent Applications: If NRL elects to apply for a patent, the contractor shall:

3.2.1 Prepare an initial draft patent application, draft informal drawings, and a draft Invention Disclosure Statement (IDS). NRL will typically make the inventor available to meet with the person preparing the draft patent application. The contractor shall draft the claims section to cover a range of claims from the broadest coverage permitted under the known prior art to the narrowest coverage. Claims shall not be in multiple dependent form.

3.2.2 Review the draft documents in accordance with its normal, internal review procedures; however, the contractor's internal review must be accomplished by a patent attorney with at least seven years experience in preparing patent applications as a patent attorney.

3.2.3 Forward the draft documents to NRL under a letter specifically identifying the individuals who prepared the documents and the attorney who reviewed them.

3.2.4 Upon receipt of NRL's comments, the contractor shall revise the draft patent application to incorporate NRL's comments, and submit a final draft patent application, IDS, and informal drawings to NRL.

3.2.5 The contractor's informal drawings shall be suitable for initial submission with the patent application to the USPTO; NRL presently intends to prepare its own formal drawings.

4.0 Time Periods to Complete Patent Applications:

4.1.0 When NRL provides an invention disclosure to the contractor, NRL will provide a due date for the patent application based on the application's priority and the invention's complexity. Although the following priority levels are permitted, NRL expects that the overwhelming majority of its disclosures will be (a) normal priority. The following is a list of priorities and due dates.

4.1.1 Normal priority: the initial draft patent application is due within four weeks of receiving the authority to prepare the application.

4.1.2 Normal priority, complex applications: the initial draft patent application is due within six weeks of receiving the authority to prepare the application.

4.1.3 Expedited priority: the initial draft patent application is due within two weeks of receiving the authority to prepare the application.

4.1.4 Urgent priority: the initial application is due within five working days of receiving the authority to prepare the application.

4.2.0 The contractor shall incorporate NRL's comments within five working days for normal priority applications, and within two working days for expedited and urgent priority applications.

5.0 Deliverable Items:

5.1.0 One printed copy of the patentability report with copies of the relevant art.

5.2.0 Two printed copies of the initial draft patent application, IDS, and informal drawings.

5.3.0 Two printed copies of the final draft patent application, IDS, and informal drawings.

5.4.0 A 3 1/2-inch IBM format computer disk with electronic copies of final draft patent application and IDS in WordPerfect format, version 5.2 or later. Equations, other than those capable of entry on a single line, shall be in WordPerfect format, version 5.2 or later. Chemical structures shall be in ChemWindow format (BioRad Laboratories), version 5.1 or later.

5.5.0 An invoice of the number of hours worked to accomplish the tasks and identifying the individuals performing the tasks.

5.6.0 The contractor shall provide deliverable items by overnight delivery if requested by the COR.

6.0 The Contractor shall peform other intellectual property services based upon work assignments provided by the COR. These services may include patent, trademark, and copyright issues. These services will be priced utilizing the labor rates proposed in Schedule B, and time periods to complete assignments will be assigned based upon complexity and priority in accordance with the time periods established in this Statement of Work, Paragraph 4.

CONTRACT DATA REQUIREMENTS LIST

Form Approved
OMB No. 0704-0188

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY:
0002, 0004, 0006, 0008, 0010	A	TDP _____ TM- _____ OTHER _____

D. SYSTEM / ITEM	E. CONTRACT / PR NO.	F. CONTRACTOR
	N00173-00-R-MS05	

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE	17. PRICE GROUP
A001	Patent Search Report and References		18. ESTIMATED TOTAL PRICE

4. AUTHORITY (Data Acquisition Document No.)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
N/A	SOW 3.1.1	Code 1008

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
NO		ASREQ	ASREQ*
8. APP CODE		**11. AS OF DATE**	**13. DATE OF SUBSEQUENT SUBMISSION**
N/A			

14. DISTRIBUTION	b. COPIES		
a. ADDRESSEE	Draft	Final Reg	Final Repro
Code 1008		1	
Assigned Attorney		1	
15. TOTAL →		2	

16. REMARKS
Patent search report must include patentability opinion.

* Provide one week after disclosure

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE	17. PRICE GROUP
A002	Patent Application		18. ESTIMATED TOTAL PRICE

4. AUTHORITY (Data Acquisition Document No.)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
	SOW 3.2.1, 5.1, 5.3	Code 1008

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
NO		ASREQ	ASREQ*
8. APP CODE		**11. AS OF DATE**	**13. DATE OF SUBSEQUENT SUBMISSION**
N/A	N/A		

14. DISTRIBUTION	b. COPIES		
a. ADDRESSEE	Draft	Final Reg	Final Repro
Code 1008	1	1	
Assigned Attorney	1	1	
15. TOTAL →	2	2	

16. REMARKS
Draft patent application will be revised upon receipt of NRL's comments and submitted in final form with four weeks or as needed.

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE	17. PRICE GROUP
A003	Diskette with Final Application		18. ESTIMATED TOTAL PRICE

4. AUTHORITY (Data Acquisition Document No.)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
	SOW 5.4	Code 1008

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
NO		ASREQ	ASREQ*
8. APP CODE		**11. AS OF DATE**	**13. DATE OF SUBSEQUENT SUBMISSION**
N/A	N/A		

14. DISTRIBUTION	b. COPIES		
a. ADDRESSEE	Draft	Final Reg	Final Repro
Assigned Attorney		1	
15. TOTAL →		1	

16. REMARKS
* Must be submitted with final application.

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE	17. PRICE GROUP
			18. ESTIMATED TOTAL PRICE

4. AUTHORITY (Data Acquisition Document No.)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
8. APP CODE		**11. AS OF DATE**	**13. DATE OF SUBSEQUENT SUBMISSION**

14. DISTRIBUTION	b. COPIES		
a. ADDRESSEE	Draft	Final Reg	Final Repro
15. TOTAL →			

16. REMARKS

G. PREPARED BY	H. DATE	I. APPROVED BY	J. DATE
Code 1008			

Offerors Avaliable Support

Area of Technology:	Patent Searching		Patent Preparation					
			Staff					
	In house	Outside	Agents	Attorney < 2 yrs experience	Attorney > 2 yrs Experience	Attorney > 4 yrs experience	Attorney > 7 yrs experience	Outside
Undersea Acoustics								
Chemistry/Biochemistry								
Electronics and Electromagnetic								
Energetic Particles								
Plasmas and Beams								
Information Technology and Communication								
Materials Science and Technology								
Ocean and Atmospheric Science and Technology								
Optical Science								
Remote Sensing								
Simulation, Computing, Modeling								
Space Research and Satellite Technology								

Under "Patent Preparation Staff: Enter the resume numbers for the firm's individuals providing the expertise and experience.

This disclosure matured into U.S. Patent No. 5,939,508, Keller.

PART II. DISCLOSURE OF INVENTION

1. **GENERAL PURPOSE.** This invention relates to the discovery of a new method for obtaining high temperature polymeric materials generated from the reaction of a phthalonitrile resin and a high temperature epoxy resin. This invention also concerns the discovery of a new type or class of high temperature materials. The resulting epoxy-phthalonitrile copolymers have improved physical properties relative to the individually cured epoxy resin system or phthalonitriles. The epoxy-phthalonitrile copolymers can potentially be used as matrix materials for advanced composites, as high temperature adhesives, as coating materials, and for numerous applications in the microelectronic industry.

2. **BACKGROUND.** In recent years, there has been a growing requirement, particularly in aircraft and missile applications, for polymers capable of withstanding temperatures in excess of 150°C for short and long term usage. Several polymers offer this capability but they all suffer from adversed processing characteristics which have hindered widespread acceptance. Since the late 60s, polymeric developments have been mainly concerned with improvements in processability of existing systems and in the design of monomers or oligomeric prepolymers that are terminated by reactive end groups yielding addition-type polymerization reactions to afford thermosets.

The use of structural adhesives and fiber-reinforced composites in aircraft, guided weapons, ships, and vehicle construction has increased markedly in the last two decade and this dramatic growth shows every sign of continuing in the future. Conventional epoxy polymers are widely employed as the basis for adhesive compositions and as the matrix material for fiber-reinforced composites. These materials incorporate a curing agent and need only heat to initiate cure. When cured, epoxy polymers are highly cross-linked amorphous thermosetting polymers and this structure results in many useful properties such as high modulus, low creep, and good performance between 100-150°C. Highly aromatic, highly cross-linked epoxy polymers such as novolac epoxy resins can be used at higher temperatures. Epoxies, however, have several disadvantages especially when being used as matrix material for composites. Problems include complicated logistics of handling due to low temperature storage requirements for the prepreg with limited shelf life (commonly 6 months at -18°C), brittleness with poor resistance to crack growth, and engineering reliability attributed to delamination, which results from water penetration into the interface between the matrix material and the reinforcing fiber. In contrast, prepreg fabricated from phthalonitrile prepolymers can be stored indefinitely until needed at room temperature without further reaction. The phthalonitrile polymers show excellent thermal stability when heated in air at 315°C for extended periods, exhibit outstanding flame resistance, and are self-extinguishing in a high temperature flame. These polymers also have a low affinity for water (<1.2%), which makes them ideal

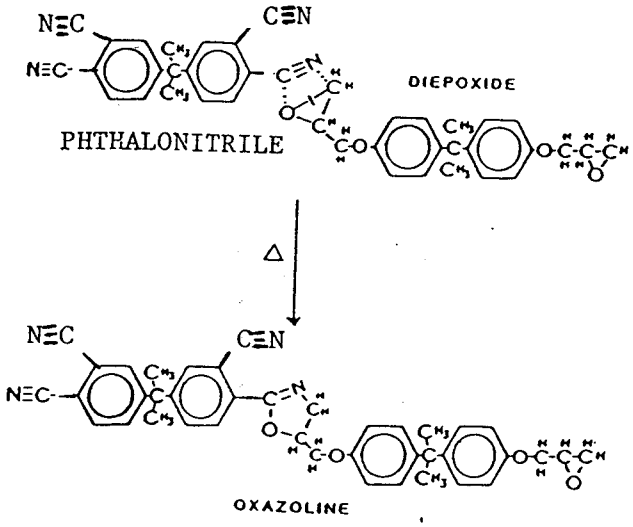
candidates for composites and electronic applications. The phthalonitrile polymers, however, have the disadvantage of requiring higher cure temperatures and longer cure periods relative to the epoxies. In essence, an ideal high performance or high temperature polymeric system would take advantage of the short cure times and low cure temperatures of the epoxies with the high temperature capability and water resistance of the phthalonitrile polymers.

3. **DESCRIPTION AND OPERATION.** A new high temperature copolymer resin system has been synthesized from the reaction of glycidyl ethers of aromatic polyhydroxy compound, e.g., epoxy novolac resins, tris(hydroxyphenyl)methane-based epoxy (Dow's TACTIX 742 resin), etc. and N,N,N',N'-tetraglycidyl-4,4'-methylenebisbenzenamine (Ciba Geigy's Araldite MY-720), with phthalonitrile-based resins. Compared to the bisphenol A-based epoxies, the multi-epoxy functionality produce tighter cross-linked

Multi-epoxy aromatic + Phth. Resin $\xrightarrow{\text{Heat}}$ High Temp. Copolymer

cured systems with (1) improved resistance to acids, bases, and solvents, (2) retention of good mechanical properties at high temperatures, (3) minimal shrinkage for accurate reproduction, and (4) improved high temperature adhesive properties. The properties of the resulting epoxy-phthalonitrile copolymer can be varied by varying the ratio of the reactants. The polymerization reaction of epoxies and phthalonitriles can be performed either neat (longer reaction times) or in the presence of a small quantity of curing additive (shorter reaction times), e.g., amines, strong organic acids, lewis acids and bases, phenols, and metallic salts or combination therefrom. The reaction probably occurs in a similar manner to that reported for the copolymerization of cyanate ester resins and epoxies to form oxazoline rings.

EPOXY-PHTHALONITRILE



4. **ADVANTAGES AND NEW FEATURES.** The high temperature copolymer formed from this invention combines the good properties and characteristics of each homopolymer - epoxy and phthalonitrile. The novolac resin is a liquid at room temperature and is readily compatible with certain phthalonitrile monomers. The mixing of the novolac epoxy resin with 2,2-bis[4-(3,4-dicyanophenoxy)phenyl]-propane shows outstanding processability and long shelf-life stability of prepolymer. In all cases, the mixture can be processed at a lower temperature relative to polymerization of the phthalonitrile. Upon curing, the copolymer exhibits outstanding and superior oxidative stability relative to novolac-based polymers and in some instances to phthalonitrile cured resins, respectively. The copolymerization reaction resulting probably in the formation of oxazoline rings appears to occur more readily than the homopolymerization of phthalonitrile. Surprisingly, a copolymer formed from a 50/50 weight percent novolac epoxy-2,2-bis[4-(3,4-dicyanophenoxy)phenyl]propane mixture shows superior thermo-oxidative stability relative to 2,2-bis[4-(3,4-dicyanophenoxy)phenyl]propane cured with 4% by weight of 4,4'-bis(4-aminophenyl)sulfone. The copolymers exhibit the following advantages over the conventional high temperature epoxy resins: (1) higher thermal and oxidative stability, (2) higher glass transition temperatures, and (3) improved shelf-life of prepolymer. Improvements relative to phthalonitriles include enhanced processability at lower temperatures, a reduction in cure time, and lower cost. The synergistic effect (see Figure 1) displays by the copolymer enhances its importance for component design for numerous applications including high temperature composites for ships and aircraft, high temperature adhesives, and microelectronics.

5. **ALTERNATIVES.** This is the first reported synthesis of a high temperature copolymer formed from the reaction of high temperature epoxy resins and phthalonitriles.

6. **CONTRIBUTION BY INVENTORS.** This invention was conceived and carried out as a part of my research endeavor on high temperature polymers.

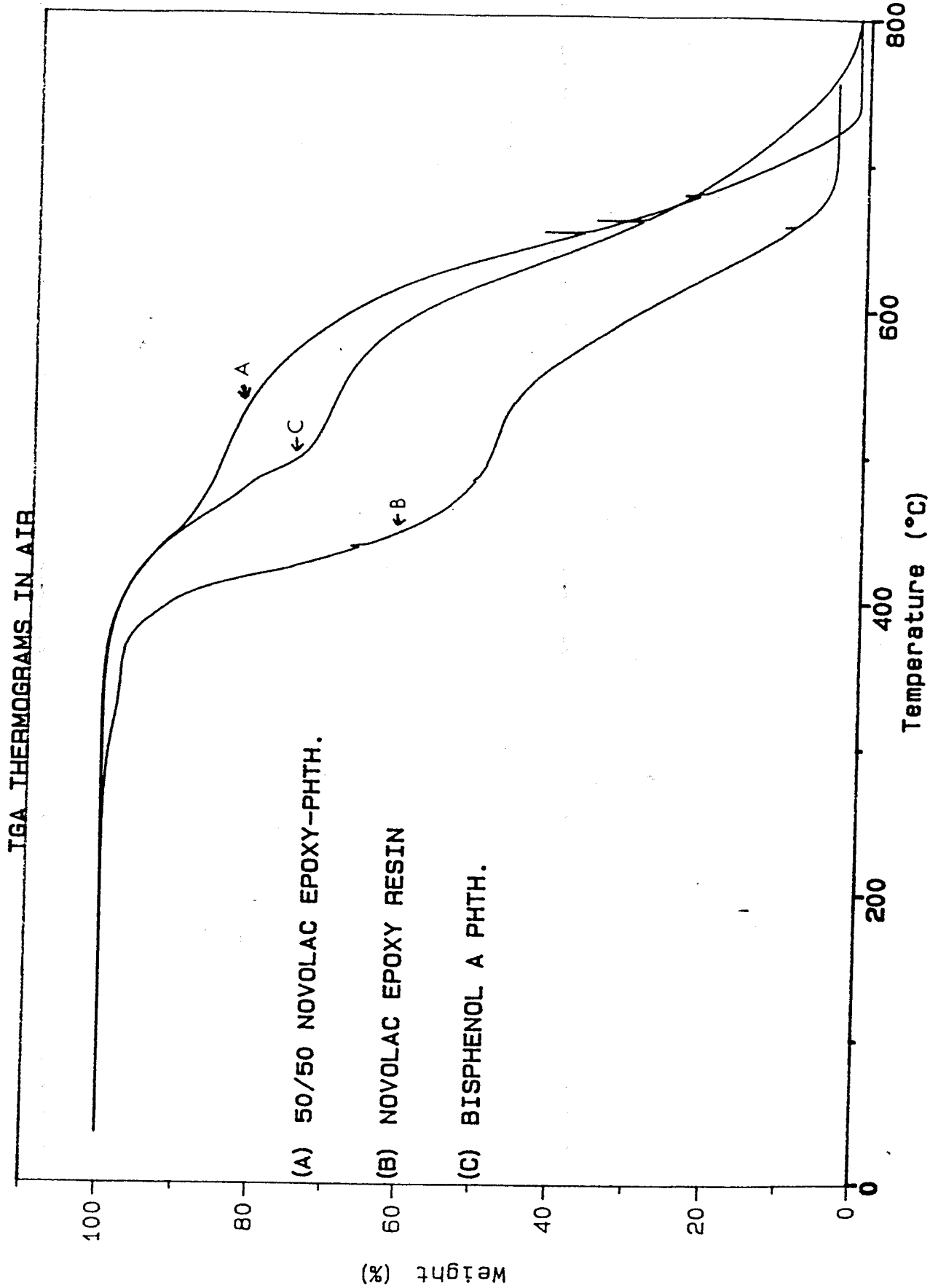
7. **EXECUTION OF DISCLOSURE.**

Inventor	Date
Teddy M. Keller	2/18/94

Disclosed to and understood by me on

Witnesses	Date
James D. Kilburn	2/18/94
James R. Griffith	2/18/94

Figure 1


TGA THERMOGRAMS IN AIR
(A) 50/50 NOVOLAC EPOXY-PHTH.
(B) NOVOLAC EPOXY RESIN
(C) BISPHENOL A PHTH.
A
B
C
Weight (%)
100
80
60
40
20
0
0
200
400
600
800
Temperature (°C)

This disclosure matured into U.S. Patent No. 5,955,849, Tang et al

Naval Research Laboratory

Invention Disclosure

Inventors:

Dr. Cha-Mei Tang, Dr. Antonio C. Ting, (*Naval Research Laboratory*), and Thomas A. Swyden (*FM Technologies, Inc.*)

I. Title of the Invention:

Integrated Collimating-Grid Field-Emission Arrays

II. Purpose of the Invention:

The primary purpose of this invention is to produce collimated electron beams from gated field-emission arrays on a single substrate. These arrays will have applications in flat panel displays (especially small displays), as cathodes for radiation sources, cathodes for accelerators, etc.

III. Prior Art:

The invention disclosure is related to prior art in the following areas: a) scanning tunneling microscope controlled field-emission microlens system and b) other lens designs for gated FEAs. These prior arts have in common the application of micro lenses to various electron beam sources.

Gated cathodes in the form of field-emission arrays (FEAs) were proposed by C. A. Spindt, I. Brodie, L. Humphrey and E. R. Westerberg[1-2] and published in 1976. For the gated FEAs, beam emission is controlled by varying the voltage of the gate (also called grid) electrode. Fabrication using a variety of techniques has been demonstrated. For example, FEAs can now be fabricated on silicon wafers using lithographic techniques. The electrons emerging from the tip have a wide angular spread, as shown in Fig. 1.

A. Scanning Tunneling Microscope (STM) Controlled Field-Emission Microlens System

A single field emission tip controlled by a scanning tunneling microscope in conjunction with microlenses was proposed and analyzed in Ref. 3 to form a high brightness electron

source and a low aberration beam forming system at the low-keV energy range. The only similarity with this disclosure is in the application of microscopic lenses.

STM Microlens System	Integrated Collimating-Grid FEAs
Not applicable to arrays of field emission tips	Single tips or arrays of tips
The thickness and shape of lens openings not addressed	shape and thickness of lens openings are very important
Individual tips fabricated separately	Tips mass produced using microelectronics technology
Good collimation requiring voltage gradient > 350 V/μm	Collimated beams not requiring voltage gradient > 350 V/μm

B. Other Papers on Use of Focusing Lenses

Many simulations[4,5] showing collimated beams from FEAs were performed using a grid-insulator-thin lens configuration where the voltage on the lens was lower than that of the grid. The electrons emerging from the lens were collimated. However, most of the electrons emitted from the tips did not emerge from the opening of the lens; they were intercepted by the lens, the insulator and/or the grid. The intercepted electrons were not shown in the figures of Refs. 4 and 5. Since the charging of the insulator is undesirable, designs based on a single negative lens are not practical for many applications.

The collimation of beams from FEAs using two or more lenses is also possible. Since the cost of fabrication increases as the number of lenses increases, we restrict discussion to focusing systems using no more than two lenses. Low fabrication cost is important for applications.

IV. Description and Operation of the Invention:

A. Description of the Invention

A unit of the invention consists of a field-emitting tip (cone or ridge) fabricated together with a grid electrode and one or two insulator-electrode combinations aligned in the direction of the electron beam propagation. The emission control electrode (grid) is placed near the emitter tip to extract the electrons. This unit of invention can be repeated in the

transverse dimension. A two-electrode design is shown in Fig. 2 and three different three-electrode designs are shown in Figs. 3-5. Design considerations involving the dimensions and applied voltages are described in Section IV.C.

Depending on the application, additional structures or lenses can be added after lens 2.

The lenses could be circular or linear. Circular lenses, circular grid openings and cone emitters give columns of collimated electron beams. Linear lenses, linear grid openings and ridge emitters will produce collimated sheet beams.

B. Operation of the Invention

The operation of the invention requires application of appropriate voltages to the various electrodes of the device fabricated according to design. The voltage applied to the grid electrode extracts electrons from the emitter tip. The grid voltage V_G is typically in the range of 30-200 Volts. The grid electrode of the field-emitter may be used, not only for extraction, but also for focusing by adjusting grid thickness.

Focusing is achieved by applying a high voltage V_H to the electrode adjacent to the grid such that $V_H/V_G >> 1$. The voltage gradient between the electrodes provides the focusing mechanism as shown in Fig. 6.

i) Operation of two-electrode System:
The invention can be operated by applying the appropriate voltage gradient between the electrodes. An example is given in Fig. 2. Better focusing can be obtained with higher voltage gradient, which is limited by breakdown in the insulator. For small areas of operation, higher voltage gradient may be obtainable as compared to large areas.

ii) Operation of three-electrode System:
If the collimation by the high voltage electrode is not sufficient due to the limit placed on the allowable voltage gradient, a third electrode with low applied voltage V_L can provide stronger focusing at the outer radius of the beam. The invention can be operated by applying $V_H/V_G >> 1$ and $V_H/V_L >> 1$,

Three examples are given in Figs 3-5. Figure 3 is a nonself-aligned design. Figure 4 has self-aligned electrodes 2 and 3. Figure 5 has self-aligned emitter tip, grid and lenses.

C. Design Considerations

Many potential applications of the field-emission arrays require good quality (low emittance) electron beam sources. To obtain good quality beamlets through beam collimation, we choose to apply appropriately designed microlenses and grid electrodes to FEAs. To minimize the possibility of device breakdown, the follow criteria are imposed: i) there should be no contact between emitted electrons and device structures (electrodes or the insulator material) and ii) the voltage gradient in the insulator should remain safely below the breakdown threshold. Focusing chiefly occurs at two locations: at the grid electrode as the primary focusing lens for all the rays and at the low voltage electrode (of a three-electrode system).

The design guidelines are:

i) Utilize the grid electrode as the primary focusing lens.
   a) The grid electrode of the field-emitter may be used, not only for extraction, but also for focusing by adjusting grid thickness along with high voltage applied to the adjacent electrode, as shown in Fig. 6. Simulations have shown that the grid will act as a lens with proper choice of grid diameter, grid thickness, voltage gradient between the grid and the adjacent electrode. For a given grid diameter and voltage settings, too thin a grid electrode produces no focusing effect near the emitting tip, while too thick a grid electrode produces focusing fields too far down stream from the emitting tip. An approximate parameter to start design simulations is that the diameter of the grid is slightly less than the thickness of the grid.
   b) Focusing is better for smaller angles on the grid opening (while maintaining clearance for the electrons). However, this angle is often dependent on the processing. Self-aligned silicon fabrication usually produces opening angle about 15-20 degrees.

ii) In general, higher voltage gradient between the grid and the high voltage electrode provides better collimation. However, the voltage gradient is limited by breakdown of the insulator.

V. Advantages and New Features:

- The device can be processed with many emitters over large areas.
- The device can be processed on the same wafer or substrate.
- The advantage of using FEAs to produce collimated beams is the feasibility and simplicity of producing spatial and temporal modulation.
- Some potential applications of the field-emission arrays require bright beams. For the example of the field-emission arrays, some of the concepts are based on the analysis derived by Tang, Ting and Swyden in Ref. 5.

VI. Alternatives of the Invention:

The concept of the invention remains the same, independent of the following:

1) Self aligned lenses.
   Silicon fabrication of field-emitters allows the possibility of fabricating self-aligned grid and lens electrodes. An example is shown in Fig. 5.
2) Linear lenses versus circular lenses.
   Linear lenses can be applied to densely packed field emitters as shown in Fig. 7, where the opening for the the second and third electrodes are linear while the grid electrode opening is circular. The focusing effect in the linear direction still exists, but is weaker than in the transverse direction.

3) The layout of the emitter tips on the surface of the wafer, for example, linear rows, or around edges of squares, rectangles, triangles, circles, etc.
4) Variations of diameter and thickness of grid and lenses for different applications.
5) Distance separating electrodes.
6) Materials used in the fabrication of the device.
7) Fabrication method.

VII. Contributions by Inventors:

a) What date did you first think of this invention:

The need of collimated beams for high frequency application was recognized on November 1, 1991. Between November 1991 and January 1992, we tried various other methods to collimate the beam from FEAs. Beginning in early March 1992, we started running simulations with collimating-grid FEA idea.

b) What records do you have to substantiate this conception date, including record books, letters, notes, drawings, reports, etc? (Identify such records and their location. State the date of the first drawing, if any).

- The first drawings, utilizing the lens system for high frequency application of FEAs, are in the Computation Book of Cha-Mei Tang titled, "New Ideas and Analysis" used from October 1990 to Present, on pages 28-30.
- Simulation results using high voltage for the collimating grid FEA idea is dated before March 5, 1992 in the Computation Book of Tom Swyden titled, "NRL-Computer Work Log" and used from June 18, 1989 to Present, starting on pages 108.

c) Contributions by Inventors. If this is a joint invention, indicate what contribution was made by each inventor.

Dr. Tang proposed utilizing the grid for focusing in addition to beam extraction and the initial design of lens system. With support from DARPA, we proceeded to refine the design of the lenses, as a team. Mr. Swyden made all the simulations using EGUN2.

VIII. Reduction of the Invention to Practice:

a) Have you done any actual experimental work toward carrying out the invention? (Identify laboratory notebooks.) If so, what date did you begin the work?

The design is compatible with the silicon technology at MCNC. The processing contract was divided into various stages. The first contract for making the masks, was awarded

to MCNC on February 20, 1991. The processing contract was awarded to MCNC on March 19, 1991.

The device is under fabrication by MCNC.

b) Identify any persons (other than co-inventors) who observed and understood any such experimental work.

The concept was presented to Dr. Henry Gray of NRL some time during the week of March 9, 1992.

On March 20, 1992, the concept was presented, at the sponsor's request, during the DARPA Program Review, to all the researchers funded under the same DARPA program and other government reviewers. Some of the people present were Drs. Henry Gray, Robert Parker and Y. Y. Lau of NRL, Drs. Bertram Hui and Ira Skurnick of DARPA, Dr. Gary Jones of MCNC, Dr. Capp Spindt of SRI, Dr. J. A. Saloon of AGED.

On April 14, 1992, the concept was disclosed to Tom McDonald of NRL.

c) On what date was the invention completed?

The first design based on this concept was completed by March 20, 1992. We have produced variations of designs based on the same concept. The devices are under fabrication.

IX. Closely Related Patent Applications and Publications:

The following patent disclosure utilizes the focused beam concept of disclosure.

C. M. Tang, A. C. Ting and T. A. Swyden, "Focused-Electron-Deflector Field Emission Arrays", Navy case No. - 74,713.

Other related publications are Refs. 3-5 of Sec. XI. See Sects. III.B and III.C for details.

X. Contracts:

a) Was the invention made during the course of employment by, or other performance of service for another person or a corporation with which you have a written or other agreement relating to inventions?

FM Technologies, Inc.

b) Was the invention made during the course of work on a contract?

Yes. under Contract N00014-90-c-2010 (1/31/90).

XI. Literature and Patent References:

1. C. A. Spindt, I. Brodie, L. Humphrey and E. R. Westerberg, "Physical Properties of Thin-Film Field Emission Cathodes with Molybdenum Cones", J. Appl. Phys. **47**, 5248 (1976).

2. C. A. Spindt, C. E. Holland, A. Rosengreen and I. Brodie, "Field Emitter Arrays for Vacuum Microelectronics", IEEE Trans. Electron Devices **38**, 2355 (1991).

3. T. H. P. Chang, D. P. Kern and M. A. McCord, "Electron Optical Performance of a Scanning Tunneling Microscope Controlled Field Emission Microlens System", J. Vac. Sci. Technol. **B7**, 1855 (1989).

4. W. B. Herrmannsfeldt, R. Becker, I. Brodie, A. Rosengreen and C. A. Spindt, Nucl. Instr. and Meth. **A298**, 39 (1990).

5. C. M. Tang, A. C. Ting and T. Swyden, "Field-Emission Arrays - A Potentially Bright Source", Nucl. Instr. and Meth. **A318**, 353 (1992).

XII. Execution of Disclosure:

Signatures and dates of inventors

Cha-Mei Tang 12/18/92

Cha-Mei Tang

Antonio C. Ting 12-18-92

Antonio C. Ting

Thomas A. Swyden 12/18/92

Thomas A. Swyden

Disclosed to and understood by me on December 18, 1992.

Glenn Joyce

Bahman Hadizi

Figure Captions

Fig. 1. The electron trajectory from the field-emission tip without focusing for grid diameter of 1.1 μm, grid thickness of 0.7 μm, grid opening angle of 22.5°, tip radius of 185 Åand applied grid voltage of 90 Volts. The tip of the emitter is level with the bottom of the grid electrode. The accelerating voltage beyond the grid is 6.5 V/μm. The electron trajectory is typical of a large range of tip and gate parameters.

Fig. 2. Two-electrode design utilizing the grid as a focusing lens by applying a high voltage to the adjacent electrode. The diameter of the grid and the second electrodes are 1.1 μm and 1.4 μm, respectively. The thickness of of the grid and second electrodes are 0.7 μm and 0.4 μm, respectively. The separation of the grid and second electrodes are 2.5 μm. The applied voltage to the grid and the lens electrodes are 90 Volts and 965 volts, respectively. The opening angle of the electrodes are 15°. The radius of the emitter tip is 185 Å. The tip of the emitter is level with the bottom of the grid electrode.

Fig. 3. A three-electrode nonself-aligned example, based on the design consideration of this disclosure. The diameters of the grid, second and third electrodes are 1.1 μm, 3.4 μm and 5.5 μm, respectively. Their electrode thicknesses are 0.7 μm and 0.4 μm, respectively. The distance between the electrodes are 2.5 μm. The applied voltage are V_G = 90 Volts, V_H = 965 Volts and V_L = 50 Volts. The opening angle of the grid electrode is 15°. The radius of the emitter tip is 185 Å. The tip of the emitter is level with the bottom of the grid electrode.

Fig. 4. A three-electrode example with self-aligned opening for second and third electrodes based on the design consideration of this disclosure. The diameters of the grid, second and third electrodes are 1.1 μm, 6.0 μm and 6.0 μm, respectively. Their electrode thicknesses are 0.7 μm and 0.4 μm, respectively. The distance between the electrodes are 2.5 μm. The applied voltage are V_G = 90 Volts, V_H = 965 Volts and V_L = 50 Volts. The opening angle of the grid electrode is 15°. The radius of the emitter tip is 185 Å. The tip of the emitter is level with the bottom of the grid electrode.

Fig. 5. A three-electrode example, where the emitter cone and the opening of all the electrodes are self-aligned based on the design consideration of this disclosure. The opening angle of of the grid electrode is 15°. The diameter of the grid is 1.1 μm. Their electrode thicknesses are 0.7 μm and 0.4 μm, respectively. The distance between the electrodes are 2.5 μm. The applied voltage are V_G = 90 Volts, V_H = 965 Volts and V_L = 100 Volts. The opening angle of the grid electrode is 15°. The radius of the emitter tip is 185 Å. The tip of the emitter is level with the bottom of the grid electrode.

Fig. 6. The focusing electric field E and two equal potential lines illustrating the focusing concept of the collimating-grid.

Fig. 7. Field-emission arrays with linear lenses openings for the second and third electrodes, while the grid electrode opening is circular.

Fig. 1.

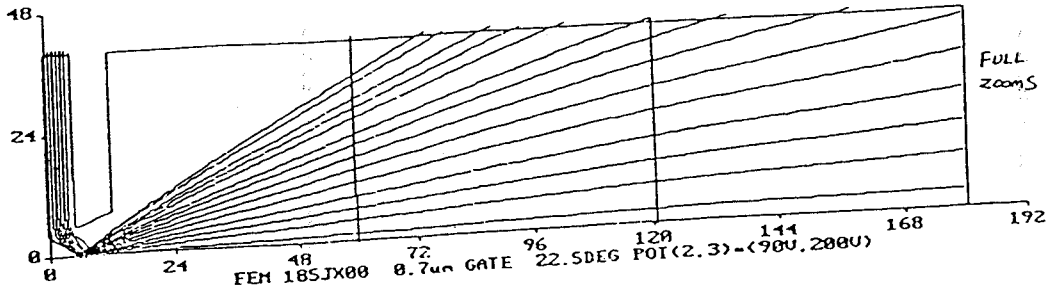


Fig. 2

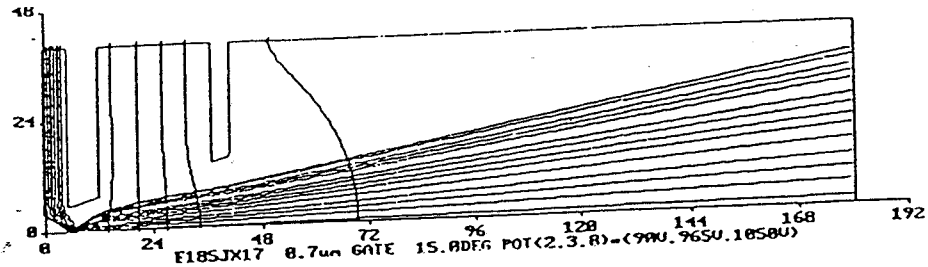


Fig. 3.

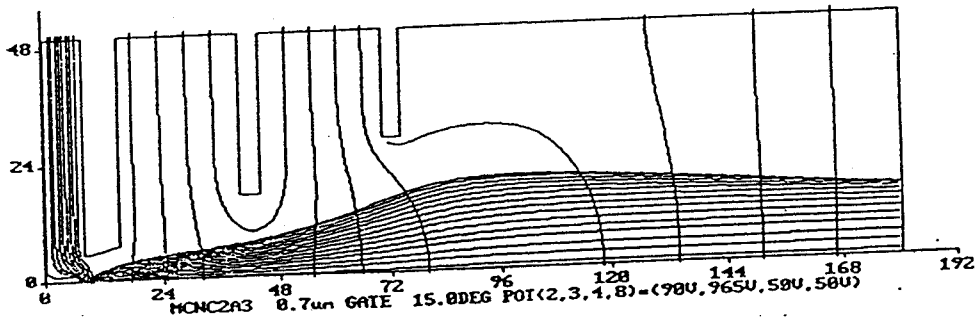


Fig. 4

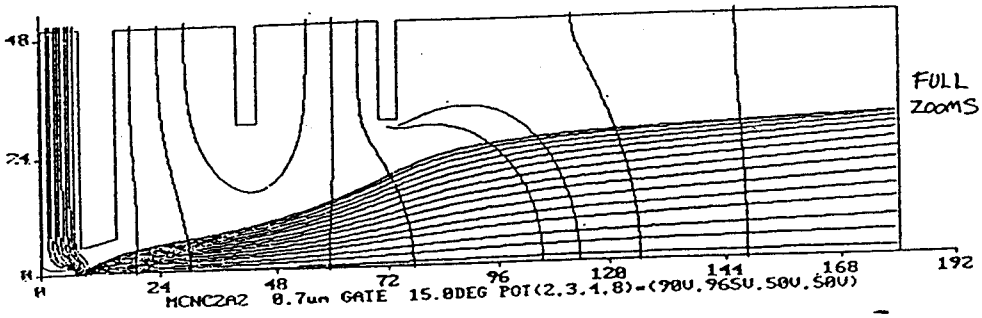
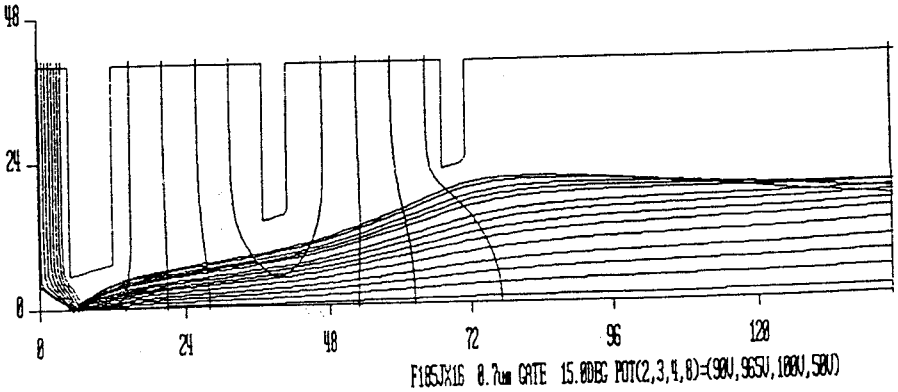


Fig. 5



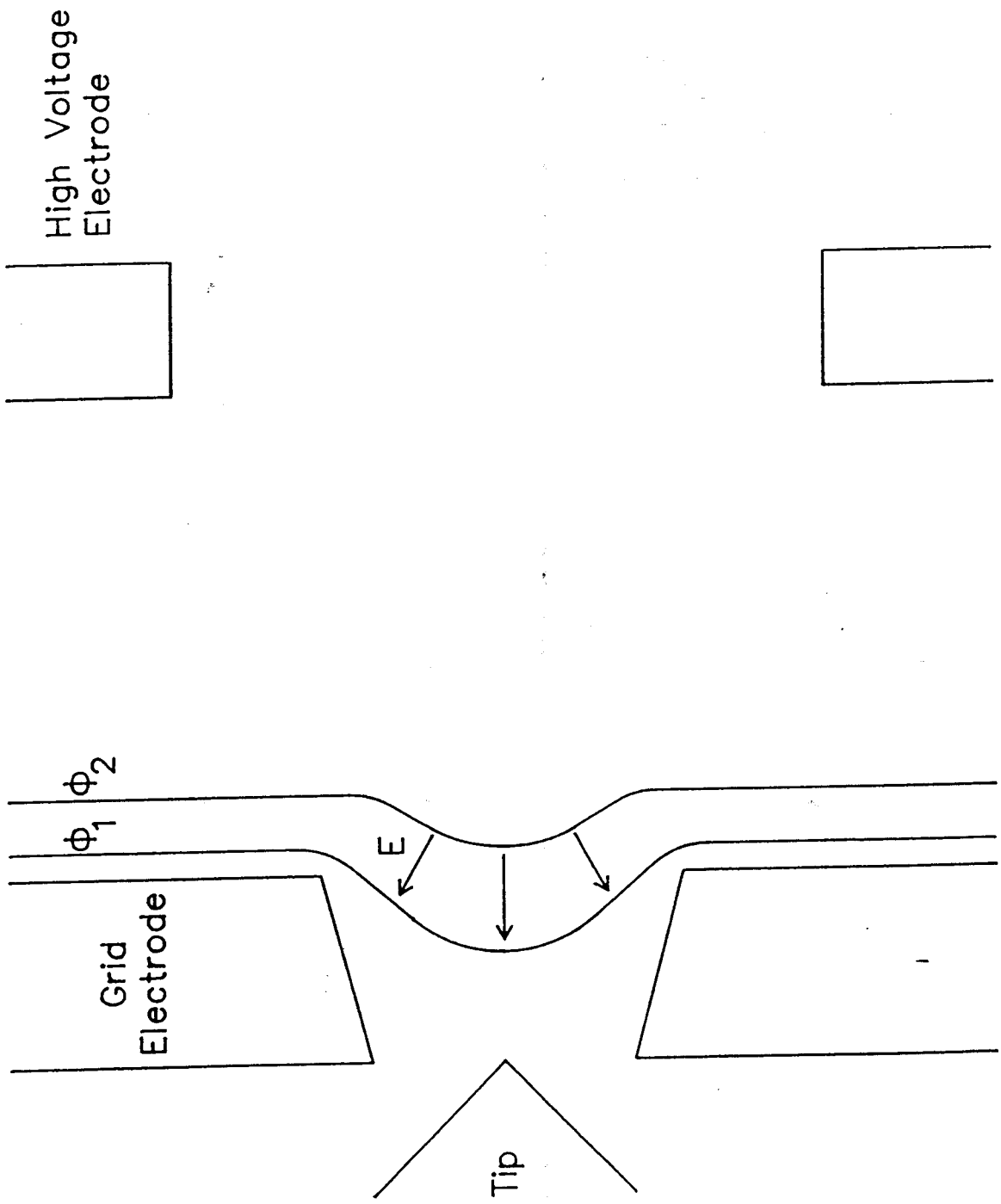


Fig. 6

Top View

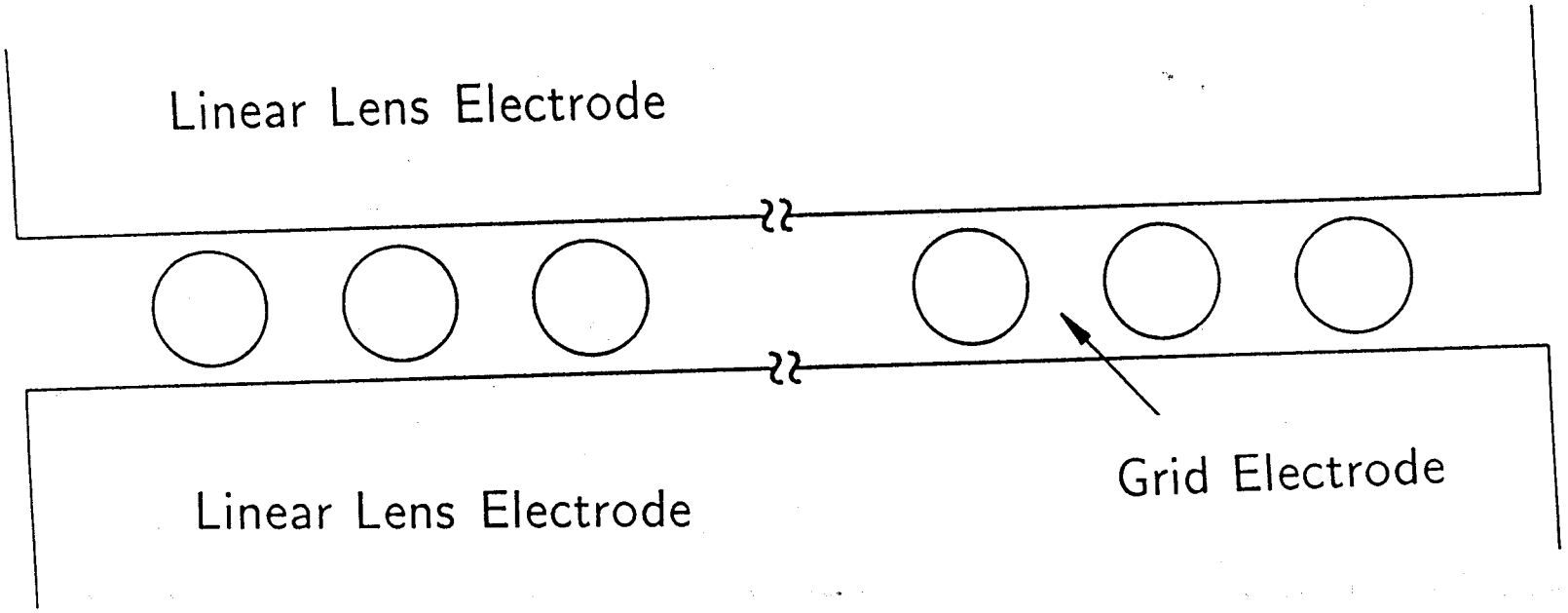


Fig. 7